

Clinical examination of the knee

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Referred pain

Pain referred to the knee

The front of the knee represents the second and third lumbar dermatomes. Two structures, the hip and third lumbar nerve root, are apt to give rise to referred pain in this area. When referred pain to the knee is suspected, the diagnostic points in the history are the indefinite area of complaint and radiation 'upwards' along the anterior aspect of the thigh. When asked for the exact site of pain, the patient points to the whole suprapatellar area and the front of the thigh. In vague anterior knee pain, the lumbar spine and the hip joint must be examined immediately. This is especially so in children who complain of knee pain but who are in fact developing hip disease, such as aseptic necrosis or epiphysiolysis. Another common error is to take a radiograph of an elderly person's knee because the pain is felt here, and then almost certainly to find some osteoarthritis at the knee but to miss the osteoarthrotic hip.

The back of the knee is innervated by the first and second sacral segments. Disorders of the first and second sacral roots, and also the sacroiliac joints, can refer pain to this area. Again, the patient cannot point exactly to the site of pain. The pain distribution remains vague and spreads upwards along the thigh or downwards in the calf. There is also no history of relevant trauma. Compression of S1, caused either by a primary posterolateral protrusion in a young adult or by a narrowed lateral recess in an elderly person, may also provoke pain at the back of the knee only. As pain is not felt in the back or buttock at the onset, the symptoms do not draw immediate attention to the possibility of a lumbar disorder. Once again, a careful history suggests the diagnosis. With a primary posterolateral protrusion, the patient will have noticed that sitting and coughing hurt the knee, whereas walking does not. In compression of the nerve root in a narrow lateral canal, complaints are

related to walking and standing, whereas bending usually relieves the pain.

Pain referred from the knee

Lesions of the knee are usually located accurately by the patient at or in the knee. Sometimes an impacted loose body complicating osteoarthritis can cause pain referred down the leg and slightly up the thigh but this is rather exceptional.

History

Knee problems are always difficult to evaluate and every possible assistance is needed to make a proper diagnosis. A chronological history, as summarized in [Box 50.1](#), is therefore the first, and sometimes even the most important, element. Cyriax used to say that one who 'doesn't have a diagnosis after the history, will hardly get one after the clinical examination'.

Age is a very important factor because some disorders at the knee appear at a certain time of life only. Anterior knee pain in an adolescent can be the outcome of Osgood–Schlatter disease, whereas the same pain in a 30-year-old sportsman is the result of infrapatellar tendinitis and in a 50-year-old lady patellofemoral arthrosis. Symptoms of internal derangement in a 17-year-old boy almost certainly indicate osteochondritis dissecans, while in a 25-year-old sportsman they may suggest a meniscus lesion and in a 60-year-old lady are probably the result of impaction of a small loose body.

The patient should be questioned about occupation and sporting activities.

Box 50.1

Summary of history taking

- Age, sex, occupation and sport
- Site of pain
- Onset
- Trauma
 - Mechanism
 - Immediate symptoms
 - Symptoms after 24 hours
- Non-traumatic
 - Sudden or gradual onset
 - What affects it?
- Evolution
 - Better/worse
 - Changing localization
 - Treatments and results
- Current symptoms
 - Localization
 - Swelling
 - Influence of movements
 - Instability
 - Twinges
 - Clicks

In knee problems there are three important symptoms that provide a great deal of information: 'locking', 'twinge' and a 'feeling of giving way'. Because the meaning of these words is not always totally understood and patients frequently confuse them, it is vital to describe what exactly is meant when asking about these symptoms.

- *Locking*: sudden (painful) limitation occurs during a movement, whereas other movements are free and painless. The knee can be locked in flexion (extension being limited) or extension (flexion being impossible).
- *Twinge*: a sudden, sharp and unexpected pain is felt. For example, the patient feels abrupt, unforeseen and sharp pain at the inner side of the knee during walking. The pain disappears immediately and normal walking again becomes possible.
- *Feeling of giving way*: this is the typical sensation in instability – a sudden feeling of weakness. It feels as if the knee cannot bear the body weight during a particular movement. The knee tends to 'collapse'.

In order to work out the diagnosis systematically and chronologically, it is as well to start with the onset of the symptoms before concentrating on symptoms at the time of examination.

Onset

- *When did it start?* Is this an acute, subacute or chronic problem?
- *How did it start?* Did the pain come on for no apparent reason or was there an injury?

If there was trauma

Describe the exact mechanism:

- In what position were the body and the leg?
- What forces were acting on the knee?

Describe the immediate symptoms:

- *Where was the initial pain?* At one side, all over or inside the joint?
- *Was there any swelling?* Immediately or after some time? An immediate effusion is always haemorrhagic and therefore indicates a serious lesion. If a swelling appears after some time, it is the consequence of a synovial reaction.
- *Did the knee give way?* Immediately or after some time?
- *Was there any locking?* If so, was the knee locked in flexion (which is typical for meniscal lesions) or was it in extension (as in impacted loose bodies from osteochondritis dissecans)? How did the knee become unlocked? By manipulation (meniscus) or spontaneously (loose body)?
- *Were you still able to walk home after the accident?*

If there was no trauma

- Did the pain come on suddenly or gradually?
- What were you doing when the pain first appeared?

- Describe the first symptoms. These may include localization, swelling, locking or loss of function (see above).

Evolution

In long-standing cases or in traumatic conditions, it is very important to have an exact idea of the evolution of the complaints.

- *Did the pain change from one side of the joint to the other or did the pain spread?* Pain moving from one side of the joint to another is characteristic of a loose body: the localization of the pain travels with the impacted loose fragment.
- *What was the evolution of the swelling?*
- *For how long were you disabled?*
- *What treatment did you have and to what effect?*
- *Have there been any recurrences?* If so, what brought them on and how did they progress?

Current symptoms

Finally, the current complaint is discussed.

- *Describe the exact localization.*
- *What brings the pain on?*
- *Do you have nocturnal pain or morning stiffness?* Pain at night usually indicates a high degree of inflammation. It occurs in acute ligamentous lesions, haemarthrosis and arthritis. Long-standing morning stiffness is usually an indication of rheumatic inflammation.
- *What is the effect of going upstairs and downstairs, and which is the more troublesome?* Going downstairs loads not only the extensor mechanism but also the posterior cruciate ligament and the popliteus tendon. Going downstairs is also very painful in impacted loose bodies.
- *Do you have twinges?* Very often, a twinge means an impacted loose body or a meniscus.
- *Does the knee give way?* Does it actually give way or just feel as though it might?
- *Does the knee click or grate?*
- *Have any other joints been affected?*

At the end of history taking, patients must be asked about their general state of health.

Inspection

In the standing position

The lower extremities are first viewed with the patient standing. Alignment of the femur, varus or valgus positions of the lower leg, pronation of the feet and alignment of the patella are observed from the front. Some genu valgum deformity in children is normal and usually disappears with growth. When

the cause is a valgus position of the heel and inversion of the forefoot, appropriate measures can be taken. Excessive genu valgum deformity in elderly patients may suggest osteitis deformans. The view from the side detects any recurvatum or lack of complete extension. Observation for tibial torsion is done standing above the patient's knees and looking downwards along the tibial tuberosity and anterior tibial crest. The coronal plane of the knee is then compared with an imaginary line connecting the medial and lateral malleoli of the ankle. Tibial torsion between 0 and 40° is normal.

In the sitting position

The most important observations of the patellar position are made with the patient seated on the examination table, the legs hanging free and the knees flexed to 90°. The examiner first assesses the patellar position and the position of the tibial tuberosity and patellar ligament by viewing the knee from the lateral aspect. Thereafter the examiner views the knees from the anterior aspect while the patient holds both knees together. Normally positioned patellae face straight ahead. Malalignment of the kneecap is seen as a patella 'looking' up and over the shoulders of the examiner (see p. 722).

In the supine position

The supine-lying position is the best from which to observe swelling at the knee joint.

Diffuse swelling indicates fluid in the joint and/or synovial swelling. In advanced arthritis or in large effusions of blood, the knee may adopt a slightly flexed position.

Diffuse swelling with muscular wasting may indicate severe and long-standing arthritis. Swelling with reddening of the skin suggests sepsis or gout.

Localized swellings are caused by bony outcrops, cysts or inflamed bursae, such as a prepatellar or infrapatellar bursa, a semitendinosus bursa, a bursa under the medial collateral ligament, a lateral or medial meniscus cyst or a Baker's cyst.

Functional examination



The routine clinical examination of the knee consists of 10 passive movements, two for the joint and eight for the ligaments, and two resisted movements (Table 50.1). If signs warrant, or if suspicion of meniscal lesions or instability arises from the history, complementary tests can be performed.

Palpation for tenderness is only carried out along the structure identified by the functional examination and therefore is only performed after the functional examination. However, palpation for heat, fluid and synovial thickening is performed before the functional examination.

Two primary movements for the joint

As in the elbow, the range of rotation becomes restricted only in advanced arthritis. Therefore extension and flexion

(Fig. 50.1) are the two movements used to test the mobility of the joint.

Extension

Normally, the knee can be extended until the tibia comes into line with the femur, but in young people some hyperextension can occur and is normal. Extension is limited by the posterior cruciate ligament and the posterior capsule. The end-feel is hard.

The evaluation of the end-feel during extension is extremely important and can only be tested if a correct technique is used. One hand takes the heel of the patient; the fingers of the other hand support the knee, while the thumb presses on the tibia, just below the patella. A rapid, short extension movement is

now performed by simultaneous upward movement of the heel and downward pressure on the tibia.

Flexion

A normal knee can be flexed until the heel reaches the buttock. Flexion is normally limited by contact between the thigh and calf muscles; the end-feel is therefore of the extra-articular type – softish.

A painful arc during flexion–extension is rather exceptional. When present, it indicates an impacted loose body, a torn meniscus or localized erosion of the articular edge of the femur. A painful arc can also be present in lesions of the iliotibial tract (friction syndrome or bursitis). Here pain is elicited as the tract rides over the lateral femoral condyle.

Eight secondary movements for the ligaments

Stretching the ligaments tests them for pain and laxity.

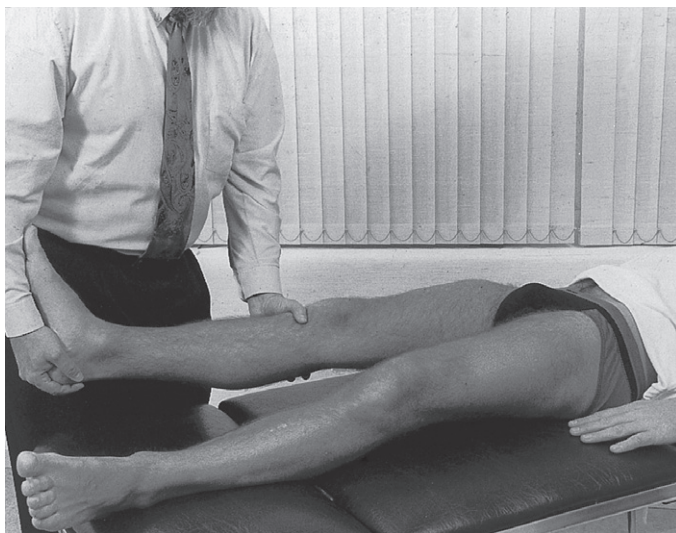
Table 50.1 Functional examination		
Testing	Movements	
1. Test for heat, swelling, synovial thickening		
2. Testing movements		
Joints	Flexion	Extension
Ligaments	Varus Medial rotation Anterior drawer test Medial shearing	Valgus Lateral rotation Posterior drawer test Lateral shearing
Resisted tests	Resisted flexion (Resisted medial rotation)	Resisted extension (Resisted lateral rotation)
3. Retest for heat, swelling, tenderness		

Valgus strain

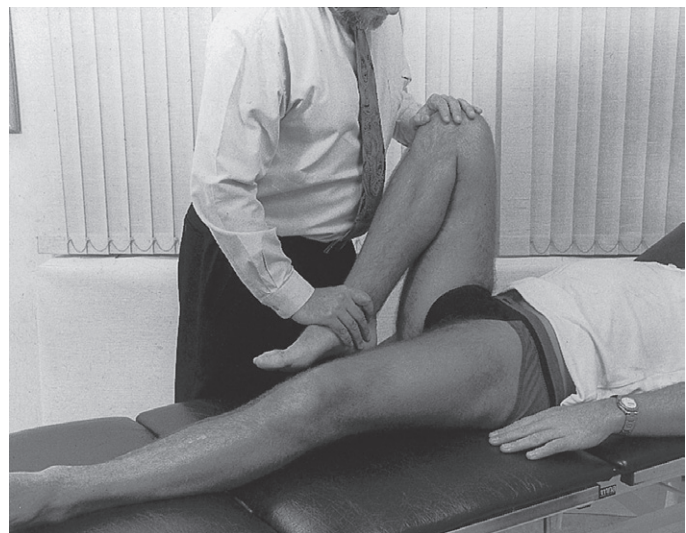
Strong valgus movement applied with counterpressure at the lateral femoral condyle tests the medial collateral ligament (Fig. 50.2a). Normally, this is done in full extension. In a minor sprain or in a minor degree of instability resulting from previous overstretching, pain and laxity are probably better disclosed if the test is repeated in slight flexion (30°).

Varus strain

Strong varus movement is applied during counterpressure at the medial femoral condyle and tests the lateral collateral ligament (Fig. 50.2b). Again, the test can be repeated in slight flexion (30°).

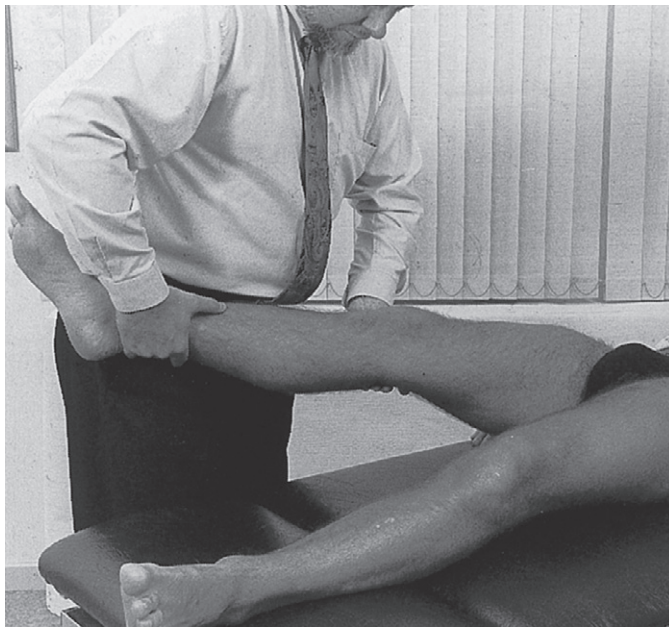


(a)

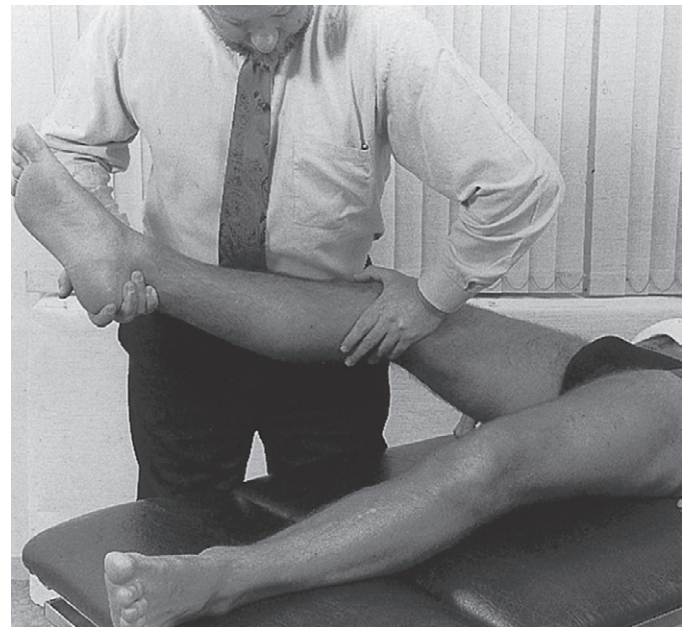


(b)

Fig 50.1 • Extension (a) and flexion (b) of the knee.

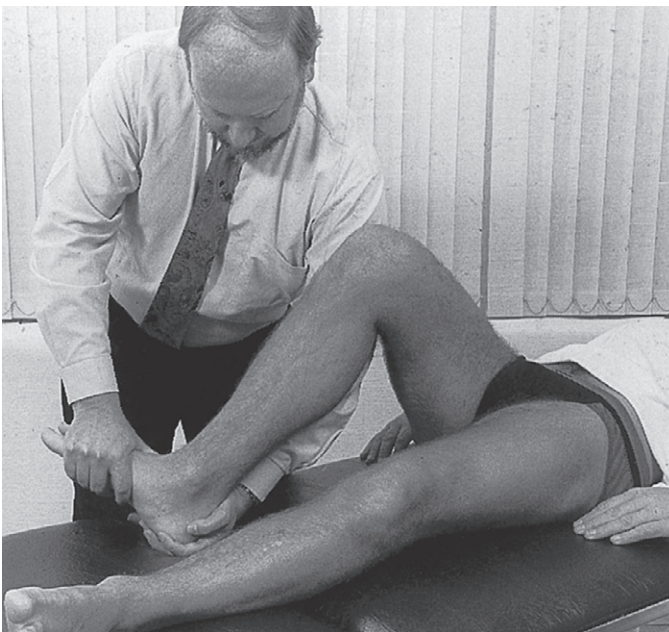


(a)

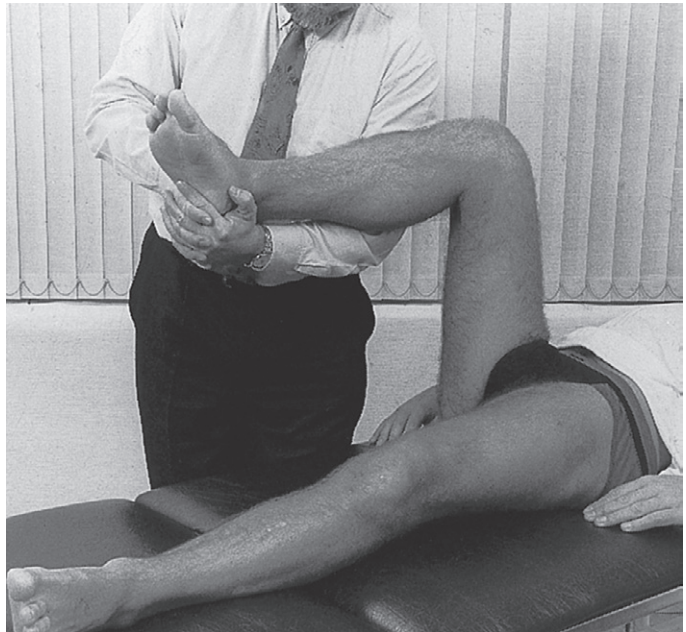


(b)

Fig 50.2 • Valgus (a) and varus (b) movement.



(a)



(b)

Fig 50.3 • Lateral (a) and medial (b) rotation.

Lateral rotation

Lateral rotation of the knee puts stress on the medial coronary ligament and the posterior fibres of the medial collateral ligament. The knee is flexed to a right angle and the heel rests on the couch. To prevent rotation in the hip, the examiner places the contralateral shoulder against the knee, the arm under the lower leg and a hand under the heel. The other hand is placed

at the inner side of the foot, which is pressed upwards in dorsiflexion. Lateral rotation is now easily performed by using the foot as a lever ([Fig. 50.3a](#)). The normal end-feel is elastic.

Medial rotation

Medial rotation puts stress on the lateral coronary ligament and the anterior cruciate ligament. The hip and knee are flexed to

right angles. The lower leg is supported by the contralateral forearm of the examiner. The hands are clasped tightly about the patient's heel, which is forced into dorsiflexion. With a combined movement of both wrists, the leg is turned into medial rotation (Fig. 50.3b). In order to protect the lateral ligaments of the ankle, it is important to exert pressure at the ankle and not beyond the calcaneocuboid joint line. The normal end-feel is elastic.

Anterior drawer test

The knee is flexed to a right angle, and the examiner sits on the patient's foot and places one hand on the patella. The other hand is placed at the back of the upper tibia, which is drawn forwards with a strong jerk to test for pain if the anterior cruciate ligament is damaged (Fig. 50.4a). The anterior drawer test in 30° of flexion ('Lachman's test') seems to be more precise in disclosing elongation or rupture in the anterior cruciate ligament (see Ch. 53).

Posterior drawer test

The examiner once again sits on the patient's foot. One hand is placed on the tibial tuberosity, while the other rests at the back of the knee. A strong backward jerk is exerted on the tibia to test the integrity of the posterior cruciate ligament (Fig. 50.4b). In a normal joint, no movement takes place and the test is completely painless.

Medial shearing strain

The knee is held at a right angle. The examiner sits opposite the patient, interlocks the fingers and places the heel of one

hand at the lateral tibial condyle, with the heel of the other hand at the medial femoral condyle. By applying a strong shearing strain, an attempt is made to move the tibia medially on the femur (Fig. 50.5a). Pain may be elicited when a loose body is present. In a tear of the lateral meniscus, this manoeuvre can displace part of the meniscus to the other side of the femoral condyle. A loud click is then heard and the full range of passive extension is immediately lost.

Lateral shearing strain

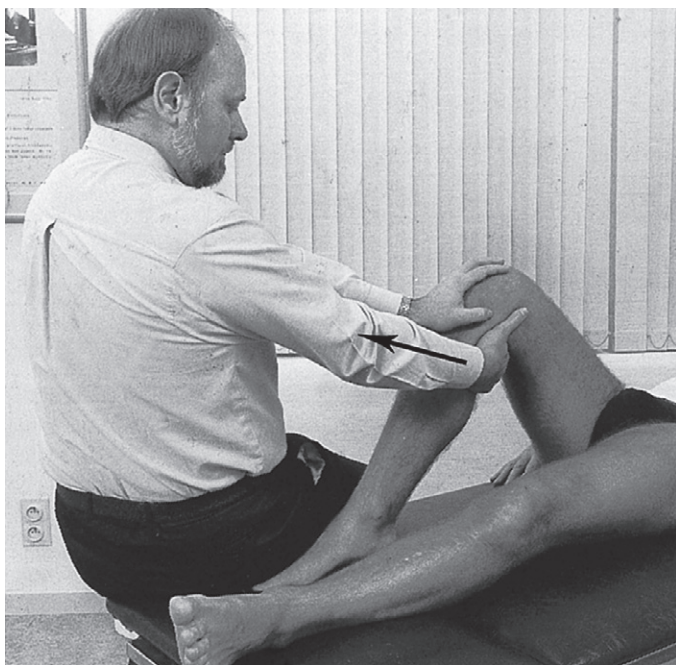
This action is the reverse of medial shearing strain. The heel of one hand is placed on the lateral femoral condyle and the heel of the other on the medial tibial condyle (Fig. 50.5b). A strong shearing force moves the tibia laterally on the femur and may provoke a click when a loose body or a longitudinal tear of the medial meniscus is present. It also elicits pain when a strain of the posterior cruciate ligament is present.

Two resisted movements for the contractile structures

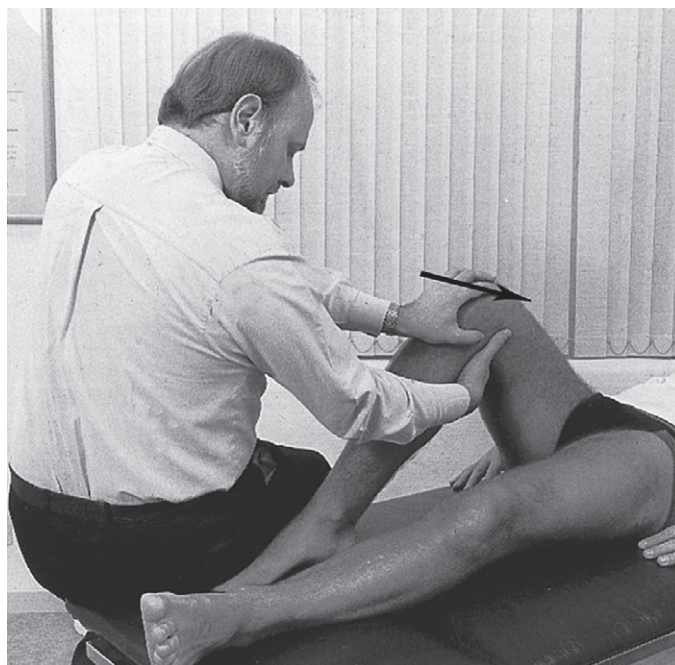
For convenience, resisted flexion and extension are tested with the patient supine, but stronger force can be exerted if he or she is prone.

Resisted extension

The knee is kept slightly bent. The examiner places one arm under the patient's knee. The other hand is placed on the distal end of the tibia, where it resists extension by the



(a)



(b)

Fig 50.4 • The anterior (a) and posterior (b) drawer tests.

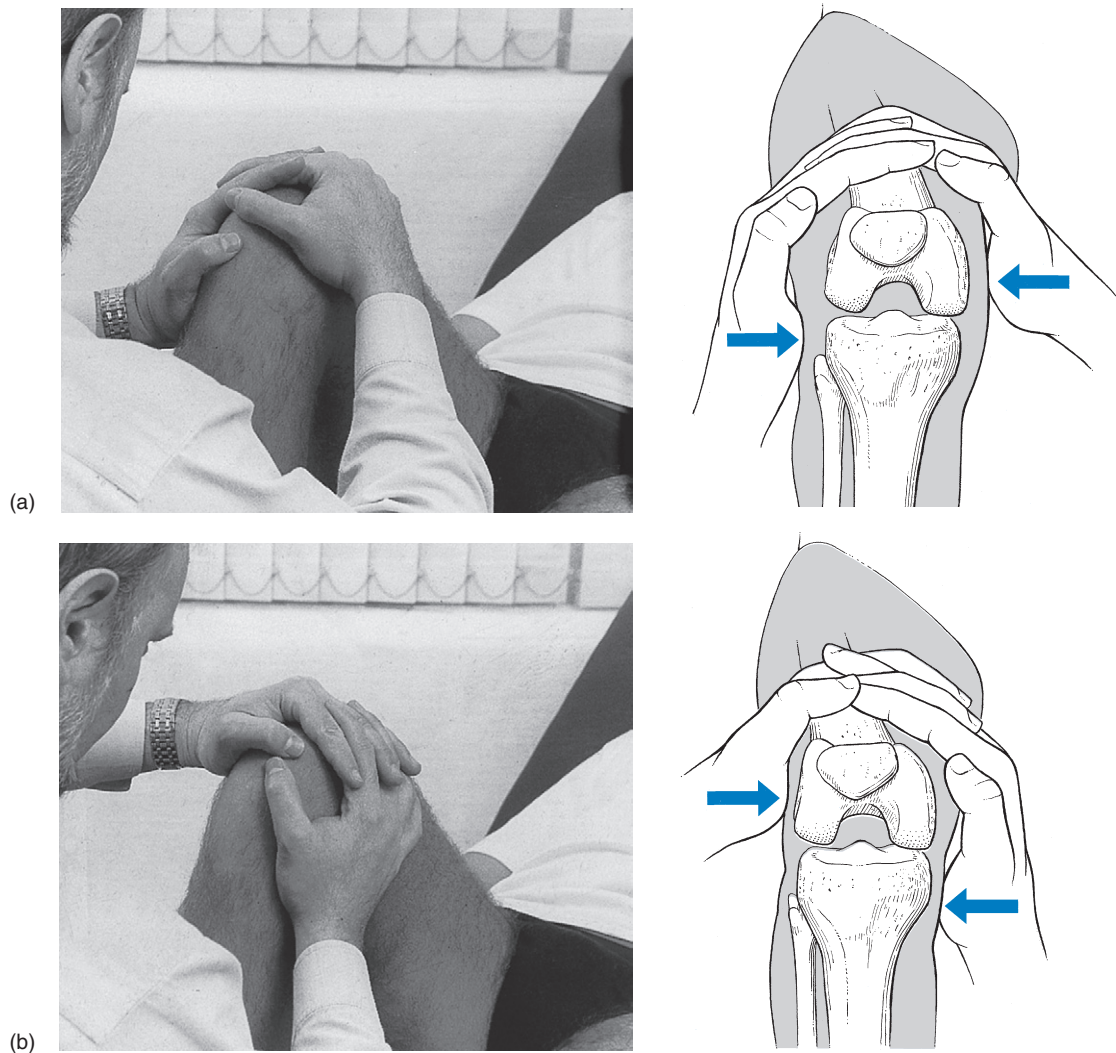


Fig 50.5 • Medial (a) and lateral (b) shearing strain.

patient (Fig. 50.6a). Pain and weakness are noted. If there is any pain, a lesion of the quadriceps mechanism is likely. If there is any weakness, a lesion of the nerve supply, usually the third lumbar nerve root, is present. Pain *and* weakness occur in a fractured patella or after a major rupture of the muscle belly.

Resisted flexion

The hip and knee are bent at right angles. The patient's heel is supported by the hands of the examiner. The patient tries to move the heel downwards while the examiner applies strong counterpressure (Fig. 50.6b).

If flexion is painful, the test is repeated, this time in almost full extension, to disclose lesions of the tibiofibular ligament and the posterior cruciate ligament. Then, with the patient in a sitting position, medial and lateral rotation is tested against resistance while the knee is held passively flexed. This test distinguishes between lateral (biceps) and medial

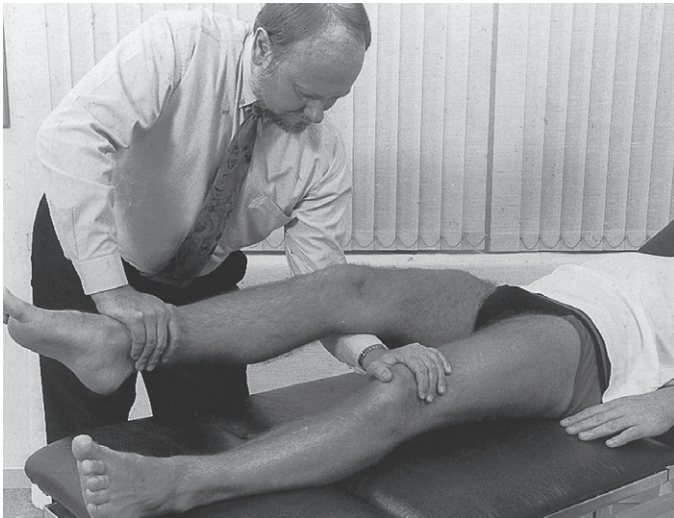
(semimembranosus, semitendinosus and popliteus) rotators of the knee.

Palpation

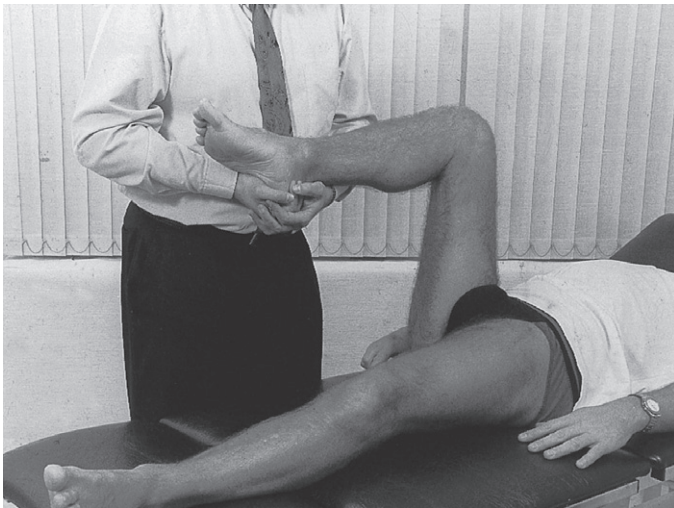
Palpation for warmth and fluid in the stationary joint is done before the clinical examination, and palpation for synovial thickening, tenderness, warmth and irregularities is done after the clinical examination. Finally, crepitus is sought during movement (Box 50.2).

Fluid

Fluid in the knee joint is a sign that is common to many disorders (traumatic, inflammatory or crystalline). Therefore, 'water on the knee' is only a statement of a sign, never a diagnosis. Testing for fluid in the joint can be done in three ways.



(a)



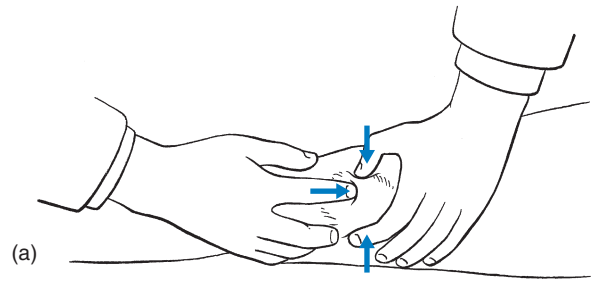
(b)

Fig 50.6 • Resisted extension (a) and flexion (b).**Box 50.2****Palpation for:**

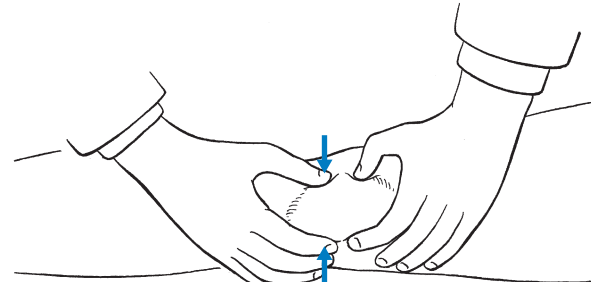
- Fluid (three tests)
- Heat
- Synovial thickening
- Irregularities
- Crepitus
- (Tenderness)

Patellar tap

This is the classic test. Manual pressure empties the suprapatellar pouch and moves the fluid under the patella. In the meantime, the thumb and middle finger of the other hand are used to press on the medial and lateral recesses until they empty. Any fluid now lies between the patella and femur. Next the index finger of the lower hand pushes the patella downwards



(a)



(b)

Fig 50.7 • Testing for fluid in the joint by patellar tap (a) and by eliciting fluctuation (b).

(Fig. 50.7a). If fluid is present, the patella is felt to move. When it strikes the femur, a palpable tap is felt, followed by an immediate upward movement. This is the sensation of an ice-cube pushed downwards in a glass of water: although the patella moves downwards, the pressure of the fluid immediately shifts the bone upwards against the palpating finger. In a normal knee, the patellar tap is not elicited.

Eliciting fluctuation

The examiner's thumb and index finger are placed at each side of the patient's knee, just beyond the patella. With the interdigital web I-II of the other hand, the examiner squeezes the suprapatellar pouch, pushing all the fluid downwards under the patella, which forces the two fingers of the palpating hand apart (Fig. 50.7b). This sensitive test will detect even very small volumes of fluid and enables an experienced examiner to differentiate between blood and clear fluid. Blood fluctuates *en bloc*, like a mass of jelly, whereas a clear effusion flows like water.

Visual testing by eliciting fluctuation

This test is not strictly palpation but relies on vision. Stroking in a sweeping motion with the back of the hand over the lateral recess and the suprapatellar pouch moves the fluid upwards and medially (Fig. 50.8a). In a minor effusion, all the fluid is moved to the medial part of the suprapatellar pouch. The lateral recess is then empty and can be seen as a groove between patella and lateral femoral condyle. Sweeping with the back of the hand over the suprapatellar pouch and downwards over the medial recess will now transfer the fluid laterally (Fig. 50.8b), where a small prominence appears. This is the most delicate test for effusion in the knee joint and demonstrates as little as 2 or 3 mL of fluid.

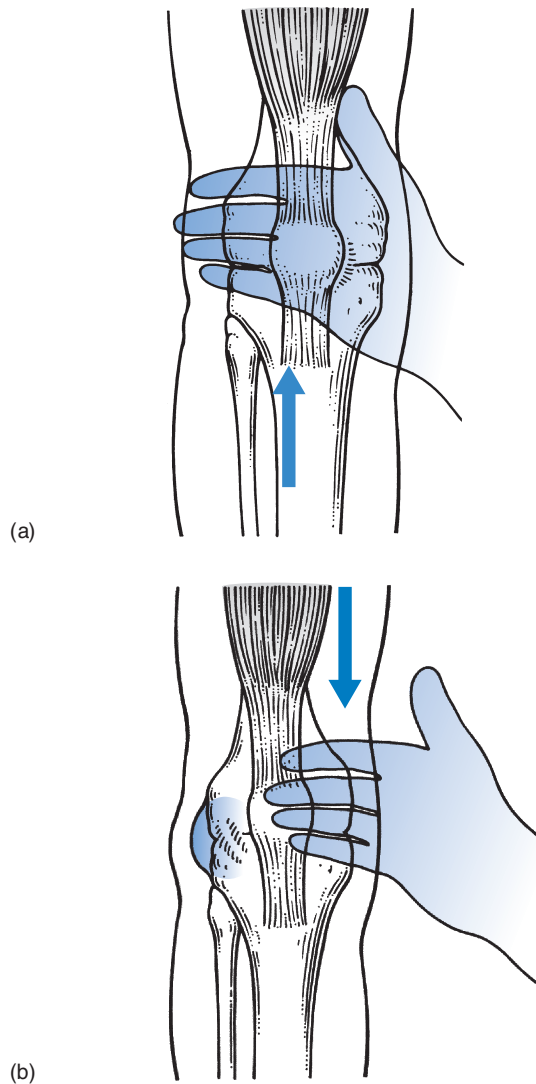


Fig 50.8 • Visual testing for fluid by eliciting fluctuation. (a) A sweeping motion over the lateral recess moves the fluid upwards and medially. (b) Sweeping downwards over the medial recess transfers the fluid laterally where a small prominence appears.

Heat

Palpation for heat is performed before and after the functional examination.

Heat, whether localized or generalized, means that the lesion is in an active stage. Generalized heat indicates capsulitis. Localized heat, sometimes only appearing after the clinical examination, indicates the presence of a minor lesion.

Heat appears in the following conditions:

- Blood in the joint
- Recent trauma or operation
- Arthritis of rheumatoid, crystalline, traumatic or bacterial origin
- Loose body impacted in an osteoarthrotic joint or an impacted meniscus
- Fracture

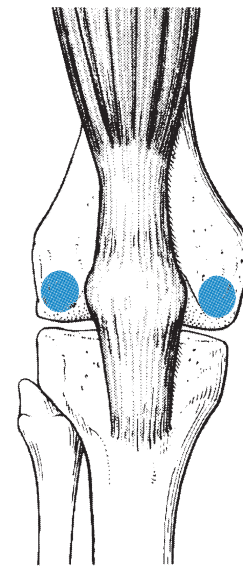


Fig 50.9 • Synovial swelling is most easily detected at the medial and lateral condyles of the femur.

- Metastases
- Osteitis deformans
- Ligamentous lesions.

Synovial thickening

Synovial thickening is a vital clinical finding. It indicates primary inflammation of the synovia and differentiates this from a secondary synovitis.

Synovial swelling is best detected at the medial and lateral condyles of the femur, about 2 cm posterior to the medial and lateral edges of the patella (Fig. 50.9). Here the synovium lies almost superficially, covered only by skin and subcutaneous fat. It is palpated by rolling the structures between fingertip and bone. Normally nothing except skin can be felt. In synovial thickening, a dense structure can be felt.

Deformities

After a fracture, or when osteophytes are present, bony deformities may be felt. Previous Osgood–Schlatter disease results in a prominence of the tibial tuberosity. Long-standing infrapatellar tendinitis may cause a bony outcrop at the patellar tip. Calcified areas in the suprapatellar pouch may form a palpable thickening but are not of clinical significance. In osteitis deformans at the tibia, the sharp anterior edge of the tibial plateau may be lost and is eventually accompanied by localized warmth.

Localized swellings may be felt all over the knee.

Some swellings are more obvious with the knee straight, whereas others are thrown into relief by flexing the knee. Ganglia and cysts related to tendons or menisci feel tense or even hard. Inflamed bursae feel softer and bimanual palpation can usually disclose some fluctuation.

Tenderness

Tenderness can be sought in the structure identified by the history and functional examination, provided the lesion lies within reach of the fingers. The two knees must always be compared carefully. Because most of the structures affected can be palpated, great diagnostic accuracy is possible.

Palpation of the moving joint

This can give an idea of the state of the opposed surfaces of the articular cartilage. However, it is important to remember that crepitus, cracking and clicking may very well appear without any pain or disablement. Some fine crepitus is also normal in middle-aged individuals. In contrast, rough crepitus indicates marked fragmentation of the surface of articular cartilage and hard creaking of bone against bone indicates that cartilage has been completely eroded. In patellofemoral arthrosis, the marked crepitus characteristic of this condition is felt only during squatting.

Accessory tests

These tests, summarized in [Box 50.3](#), are performed only if the history or clinical examination warrants them. Meniscus tests are thus performed when the history includes periods of locking.

Stability tests are used when the patient mentions a feeling of giving way, or when some laxity is detected during the routine functional examination. Patellofemoral tests are used if the history is that of anterior knee pain or patellofemoral dysfunction.

Bilateral passive rotations

The range of knee rotation can best be compared with that of the contralateral side by performing the movement simultaneously at both knees. The patient lies prone and flexes both knees to a right angle. The examiner stands at the end of the couch, grasps the patient's feet, pushes them in dorsiflexion and then simultaneously rotates both feet laterally to test external rotations and medially to test internal rotations. Range of movement and end-feel are compared.

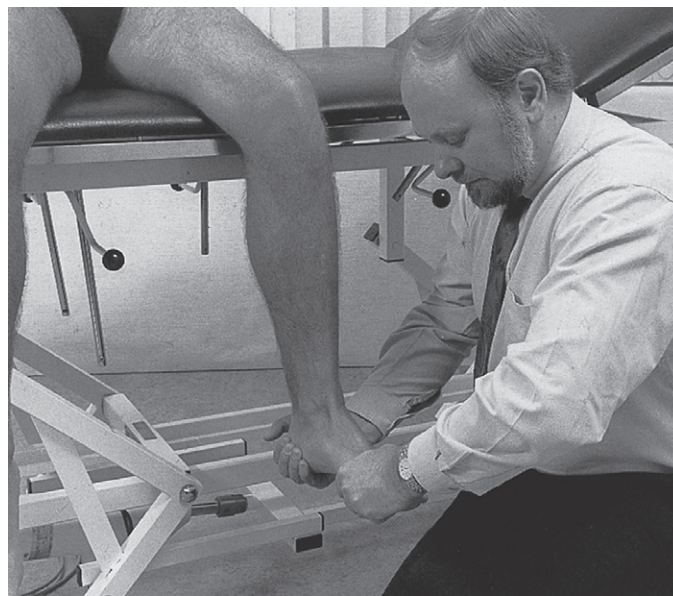
Box 50.3

Accessory tests

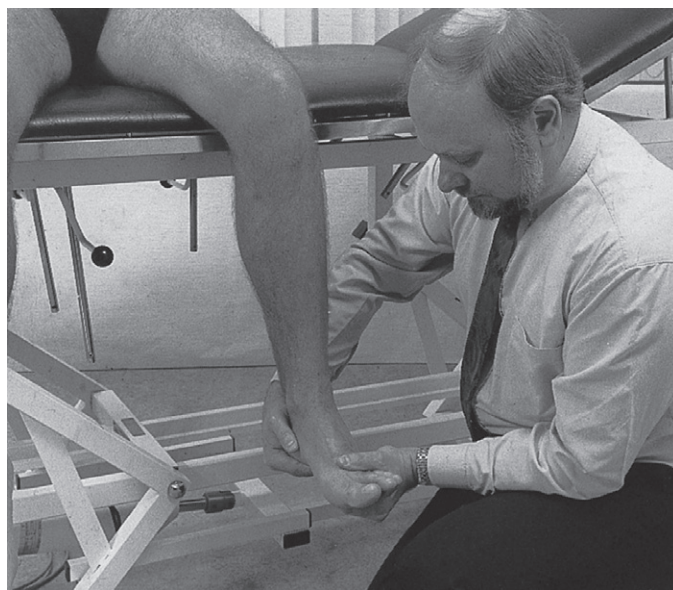
- Bilateral passive internal and external rotation
- Resisted internal and external rotation
- Stability tests
- Meniscus tests
- Patellofemoral tests
- Squatting

Resisted internal and external rotation

The patient sits on the table, the knee flexed to a right angle and the legs hanging over the edge. The examiner holds the foot in dorsiflexion and asks the patient to press outwards and inwards, meanwhile maintaining the neutral position with both hands. Internal (medial) rotation tests the medial hamstrings and popliteus ([Fig. 50.10a](#)). External (lateral) rotation tests the biceps femoris and the upper tibiofibular joint ([Fig. 50.10b](#)).



(a)



(b)

Fig 50.10 • Resisted internal (a) and external (b) rotation.

Box 50.4**Summary of the clinical examination of the knee****Inspection**

- Standing
- Sitting
- Supine-lying

Basic functional examination

- Two primary movements for the joint
 - Passive flexion
 - Passive extension
- Eight secondary movements for the ligaments
 - Valgus strain
 - Varus strain
 - Lateral rotation
 - Medial rotation
 - Anterior drawer test
 - Posterior drawer test
 - Medial shearing strain
 - Lateral shearing strain

Two resisted movements

- Extension
- Flexion

Palpation

- Fluid
- Synovial thickening
- Deformities
- Tenderness
- Palpation of the moving joint

Accessory tests

- Bilateral passive internal and external rotation
- Resisted internal and external rotation
- Stability tests
- Meniscus tests
- Patellofemoral tests
- Squatting

Squatting

Palpation during squatting is performed when a lesion at the patellofemoral joint is suspected. The palpating hand ascertains whether there is crepitus, which is typical in patellofemoral disorders.

Other tests

Tests for capsuloligamentous instability, meniscal lesions and patellofemoral disorders are described in Chapters 52, 53 and 54 respectively.

Clinical examination of the knee is summarized in Box 50.4.